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154

# Improving the Supply Chain of Motor Pumps to Expand Small-scale Private Irrigation in Zambia



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Willem Colenbrander and Barbara van Koppen



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**Improving the Supply Chain of Motor Pumps to Expand  
Small-scale Private Irrigation in Zambia**

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and  
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### **Project**

The AgWater Solutions Project was implemented in several countries in Africa and Asia between 2009 and 2012. The objective of the project was to identify investment options and opportunities in agricultural water management with the greatest potential to improve incomes and food security for poor farmers, and to develop tools and recommendations for stakeholders in the sector including policymakers, investors, non-governmental organizations (NGOs) and smallholder farmers.

The leading implementing institutions were the International Water Management Institute (IWMI), the Food and Agriculture Organization of the United Nations (FAO), iDE, the International Food Policy Research Institute (IFPRI) and the Stockholm Environment Institute (SEI).

For more information on the project or for detailed reports, please visit the project website (<http://awm-solutions.iwmi.org/home-page.aspx>) or contact the AgWater Solutions Project Secretariat ([AWMSolutions@cgiar.org](mailto:AWMSolutions@cgiar.org)).



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## Summary

During the past decade, many smallholder farmers have adopted the use of motorized pumps for irrigation in Zambia. While research has been carried out on the demand for irrigated high-value crops and most aspects of irrigated crop production, no knowledge has been generated as yet about the supply chain of motorized pumps. The present study fills that gap by systematically analyzing the different components of the supply chain and by identifying imperfections that exist. Findings are presented on: the manufacturers and the various types of pumps that are imported; the organization of import, wholesale and retail, including after-sales services; fiscal measures to accelerate the flow of goods and services to the farmer; the prices of pumps by country of origin, size and retailer; and financing facilities to accelerate the flow of money to the suppliers. The main imperfections found are the highly centralized structure of the supply chain, financing facilities in urban hubs and the concentration of information only among a few people. Many dealers, especially the smaller ones, are not aware of the import duty waiver on irrigation equipment and pumps. Individual smallholders incur high travel costs to purchase pumps and spare parts from urban centers; they lack information about prices, which is especially relevant because of the extraordinary variation in prices of even the same pump; they are not informed and trained on the proper use and maintenance of the pumps; and they lack financing facilities to purchase pumps. It is concluded that farmers' organizations, such as the Zambia National Farmers Union (ZNFU), can play an important role in the motor pump supply chain by providing information to smallholders on importation procedures, pump types, prices and credit facilities. They can also help to improve smallholders' access to pumps through the negotiation of favorable terms for the supply of pumps, spare parts and after-sales services.



## INTRODUCTION

### Rationale

The irrigation potential in Zambia is estimated at 2,750,000 hectares (ha), assessed on water availability and soil suitability, but economically only 423,000 ha could be viably developed through irrigation. Currently, the land under irrigation is approximately 200,000 ha, which means that there is potential to, at least, double this area. Of the current 200,000 ha under irrigation, approximately 100,000 ha is in the lowlands and is irrigated by small-scale farmers for the production of winter vegetables (Government of the Republic of Zambia 2010).

Over the past ten years, portable motor pumps have become an important water-lifting technology for smallholder farmers in Zambia. There was a marked increase in their use from virtually nil to an estimated number of 15,000. This adoption is triggered by the expanding demand for irrigated high-value crops. Profit margins for smallholders using portable motor pumps are considerably higher than for those using other technologies (Colenbrander et al. 2011). Moreover, the prices of the pumps decreased. Up to the end of the 1990s, only the more expensive pumps were available, which were only used by a few better-off farmers. Since then, the retail prices of motor pumps, especially the Chinese pumps of 3 to 5 horsepower (hp), have come down from USD 200 for the cheapest 3 hp pump to USD 1,000 for the most expensive 5 hp pump. The price for the cheapest 3 hp pump is about the same as the current retail price for treadle pumps in Zambia. Assuming that each motor pump is irrigating an average of 1 ha, the total area under mechanized smallholder irrigation has increased to 15,000 ha. This represents 15% out of the total estimated 100,000 ha under individual small-scale irrigation in Zambia (Government of the Republic of Zambia 2010). These 15,000 ha already outnumber the estimated 10,000 ha which are irrigated using other agricultural water management (AWM) technologies, such as river diversions in the northern high-rainfall area of Zambia or treadle pumps in various other areas. The remaining 75,000 ha (75%) are irrigated using buckets (Colenbrander et al. 2011). As those using buckets for irrigation may well shift from buckets to motor pumps, the potential for further adoption of motor pumps is substantive.

A comparison with mechanized irrigation development in South Asia since the 1980s (Mukherji and Facon 2009), further confirms the likelihood that adoption rates of motor pumps in Zambia will continue or even accelerate. In South Asia, large community and government-managed schemes are giving way to atomistic irrigation, i.e., pump irrigation by individual smallholders (Shah 2009). In India, more than 60% of the nation's irrigation now comes from atomistic motorized pump irrigation, despite ongoing investments in government-managed irrigation schemes.

The Government of Zambia has paid limited attention as yet to individual smallholder irrigation, in general, and to its mechanization, in particular. The Irrigation Policy and Strategy of Zambia (Government of the Republic of Zambia 2004) states a general objective for smallholders: "*To empower smallholders to develop and use irrigation and other water management technologies so as to alleviate poverty and achieve food security.*" The specific objectives of the policy are: "*To rehabilitate and upgrade public sector irrigation schemes, to initiate new public sector, farmer-managed, irrigation schemes, to increase the productivity of rainwater through water harvesting, and to promote sustainable dambo (lowlands, wetlands) utilization.*" In practice, the government supports public irrigation schemes for smallholders more strongly than individual private irrigation. The ongoing and planned investment in small-scale irrigation programs amounts to USD 842 million over a period of about 10 years. Out of this amount, only USD 16 million (2%) is to be

spent on traditional and low-cost technologies used by individual smallholders (Government of the Republic of Zambia 2010).

However, the government introduced fiscal measures to support farmers. In 2003, the government introduced an import duty waiver on irrigation equipment and pumps for agricultural and horticultural purposes. In 2009, it issued a value-added tax (VAT) zero rating on small-scale agricultural equipment, including portable motor pumps. These measures were part of Zambia's gradual shift since the 1990s, from a centrally planned economy to a market economy. During this period, policymakers realized that smallholders, who irrigate 1 to 2 ha, would need incentives to remain competitive with well-established large-scale commercial farmers. The Zambia Revenue Authority (ZRA) justifies the VAT zero rating with their statement: *"To ensure that unregistered farmers who cannot claim input VAT on such equipment do not incur any VAT. The measure will also reduce input costs and enable farmers to expand production and make farming a viable sector."* It is still unclear to what extent these tax measures are implemented, and what their impacts are on the suppliers and the end-users. In sum, although policies are supportive and the government has taken some initiatives, private smallholder irrigation has received limited attention as yet.

Policy research on private smallholder irrigation has rightfully focused on the demand side and the marketing of irrigated produce (Hichaambwa 2010). Produce markets are the 'pull' factor for manual and mechanized smallholder irrigation. Spontaneous smallholder irrigation is most frequent around the capital city, Lusaka, and other urbanizing hubs, where national and international markets are flourishing.

Yet, the 'push' factors of improved supply of produce are also important. Research and policies to support the supply of produce tend to focus on agronomic practices, such as cultivation practices, fertilizers, choice of seed, water conservation and gravity or manual irrigation, in particular.

Little research has been carried out on small-scale mechanized irrigation. The author of this paper is unaware of any earlier research that has been carried out on the supply chain of motorized pumps. Imperfections in the chain may prevail. Solutions to these imperfections could further unlock the potential to mechanize smallholder irrigation. This paper aims to fill this gap.

## **Research Questions and Method**

The central research questions in this article are: (a) what is the nature of the supply chain of portable motorized pumps in Zambia and what are the current imperfections? and (b) how can farmer organizations, the government, donors and NGOs address those imperfections to accelerate motor pump adoption by smallholders?

These questions were explored qualitatively and quantitatively through a literature review and in-depth interviews held with key actors in the motor pump supply chain. These included farmers using small-scale irrigation and staff of the ZNFU, which has associations for smallholders in all districts of the country. In Lusaka, and elsewhere, 21 retail shops were visited. Interviews were held with the Customs Department of the ZRA, under the Ministry of Finance and National Planning, and a Customs Clearing Agent. Interviews were also held with the Ministry of Agriculture and Cooperatives, which is the Ministry responsible for formulation and implementation of the Irrigation Policy. Lastly, three NGOs were visited: these NGOs support farmers using small-scale irrigation by helping them to acquire irrigation equipment and provide training in the use of this equipment. Meetings were held with two micro-finance institutions (MFIs) that provide loans for the purchase of agricultural equipment to smallholders,

and one MFI membership organization. The study took place between November 2010 and November 2011, and covered the 2010-2011 rainy season and the 2011 dry season. A checklist was used for the interviews carried out with different actors in the motor pump supply chain (see Appendix 1).

The next section, *Findings: The Motor Pump Supply Chain in Zambia*, presents the findings from the study on motor pump supply chains in Zambia. This starts with the conceptualization of supply chains and compiling the chain for Zambia’s motor pumps. This overview also identifies the five issues that are subsequently discussed in further detail: manufacturers and types of motor pumps; import, wholesale, retail and after-sales services; fiscal measures; retail prices; and financing facilities.

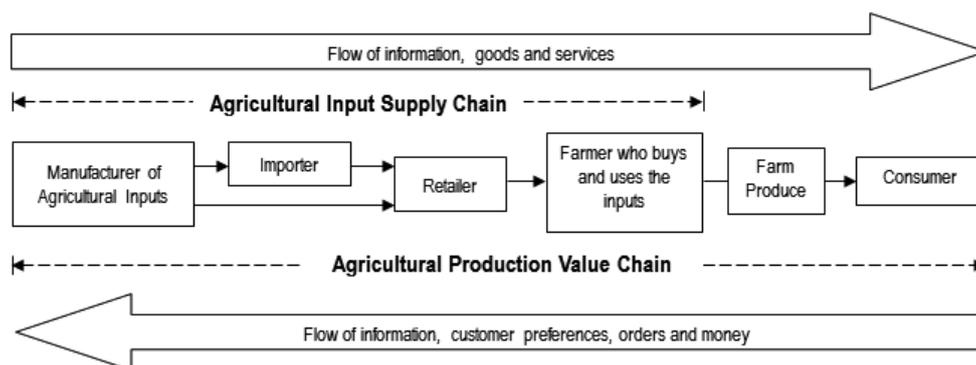
The section, *Conclusions and Recommendations*, discusses these findings in the light of the imperfections of the motor pump supply chain and makes recommendations on the possible solutions that could further unlock the potential to mechanize small-scale private irrigation.

## FINDINGS: THE MOTOR PUMP SUPPLY CHAIN IN ZAMBIA

### Conceptualization and Overview

A supply chain consists of the entire network of inter-dependent actors that deliver products and services to the same customer, in this case the Zambian smallholder farmer. Figure 1 shows how an agricultural input supply chain is an integral part of the agricultural production value chain. A perfect value chain and supply chain entails not only the flow of goods and services but also the flow of information about various aspects of the chain, such as importation procedures, prices, quality and customer preferences. The information flows are bidirectional, upstream and downstream in the chain.

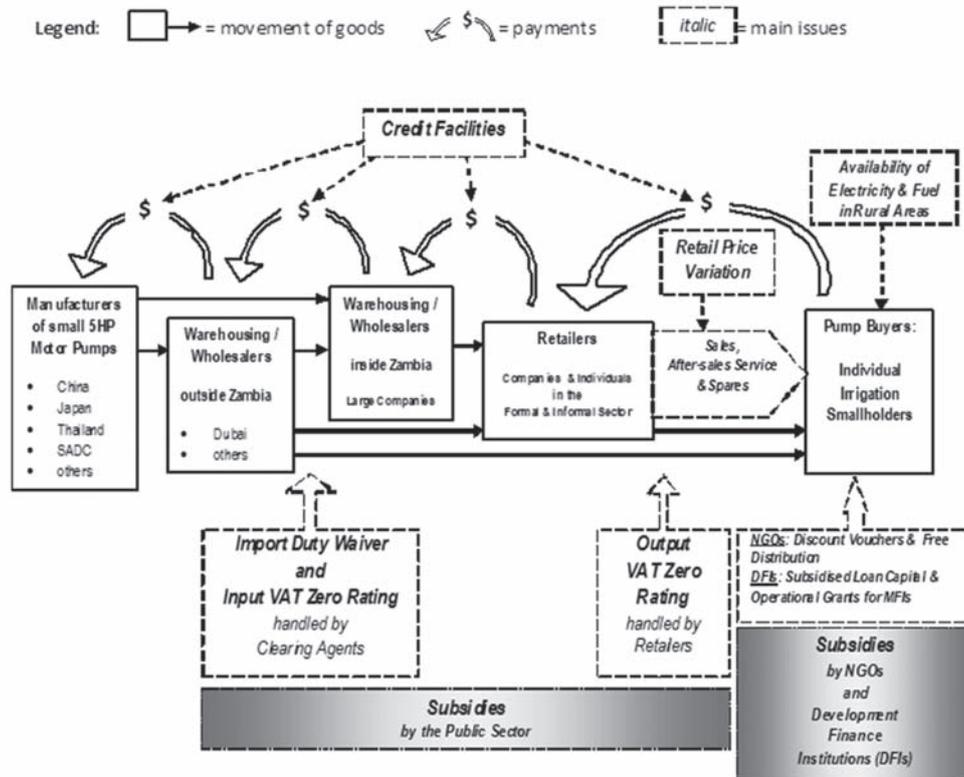
FIGURE 1. The input supply chain embedded in the production value chain.



Source: Adapted from Research into Use 2007.

This paper focuses on the supply chain of only one type of input, namely, portable motor pumps for irrigation. It looks at the manufacturers, importers, wholesalers, retailers (including after-sales services) and buyers (the farmers) of the motor pumps; it does not look at the production and marketing of the crops that are produced by the pump (Figure 2).

FIGURE 2. Actors and issues of the motor pump supply chain in Zambia.



Notes: SADC = Southern African Development Community; DFI = Development Finance Institution.

## Manufacturers and Types of Motor Pumps

As the national electricity grid in Zambia only reaches 4% of the rural population (as opposed to 47% in cities and towns), this paper focuses on motor pumps powered by petrol and diesel engines. Fuel stations are found in most districts in Zambia.

All motor pumps that are used in Zambia are imported. The most common models found are from China: King Max, Eagle, Asia, RATO, Kipor, Jiangdong, Changfa and NTC. Fewer pumps are imported from Thailand and these are mainly the pumps supplied by Honda Motor Co. Ltd., Thailand, which are manufactured under license from Honda Motor Co. Ltd., Japan. The Japanese models found are Honda, KOSHIN and Dayliff.

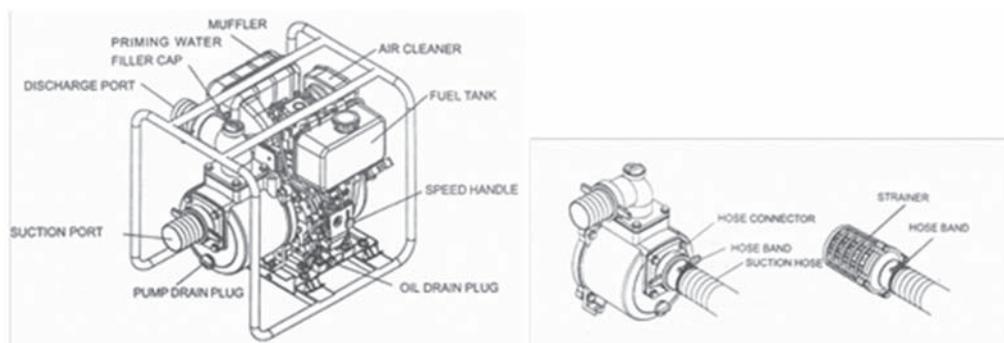
The most common models found in this study were 2 to 3-inch petrol pumps (3-5 hp, 30-60 cubic meters (m<sup>3</sup>)/hour), followed by 2 to 4-inch diesel pumps (3.5-9 hp, 20-60 m<sup>3</sup>/hour). All portable motor pumps have a suction limit of 8 meters (m).

Figure 3 shows the typical characteristics of a portable motor pump. When a farmer buys a pump for the first time, it is mostly used for flood irrigation. The farmer may add accessories, such as sprinklers or drip irrigation, at a later stage. This paper only deals with the supply chain of the motor pump and not the accessories.

## Import, Wholesale, Retail and After-sales Services

Pumps are imported by a number of large companies that also wholesale and retail the same pumps. Pumps are also imported by smaller companies that only retail their pumps.

FIGURE 3. Typical characteristics of a portable motor pump.



Source: Operational manual for Kipordiesel pump. Models: KDP20, KDP30 and KDP40 (3.5-9.0 hp).

There are two categories among the bigger importing companies: (a) those specialized in agricultural and irrigation equipment only, and (b) those that are general retail stores that also sell pumps. The headquarters of these companies are in the capital city, Lusaka, but they have branches in the urban centers along the ‘line of rail’, which is the economic hub along the north-south axis of the country. These bigger companies sell spare parts and provide after-sales services in all their shops. However, some companies only provide these services through their head office based in the capital city, Lusaka. The bigger stores usually sell a large range of pumps, from the cheaper Chinese pumps to the more expensive Japanese pumps. Not only do the bigger companies retail, but they also wholesale at a discounted retail price.

The smaller companies usually import cheaper Chinese pumps for retail only. Most of these companies do not sell spare parts or provide any after-sales services. These are the shops that are based in and around the town markets.

Companies that are providing irrigation services to farmers either import pumps themselves or buy them locally. The smaller shops buy a pump locally, only when they need a specific model for a specific client.

Pumps are also imported by individuals in the informal sector, either on order from individuals or companies. In this case, there is no provision of spare parts or after-sales services.

Out of the 21 companies visited, seven were specialized in irrigation equipment, either for retail or specifically to provide irrigation services to farmers; and the remaining 14 companies that had general retail stores that also sold pumps – eight of these were large retail stores that have been established in Zambia for some time and six of these were the smaller market stores that were only established during the past 10 years.

These findings show that the import, wholesale and retail of motor pumps are highly centralized in the urban centers along the ‘line of rail’. This centralized nature was echoed in the main complaint made by smallholders interviewed about the motor pump supply chain. They complained that there were no reliable retail shops nearby for the purchasing of motor pumps and spare parts, and no provision of repair facilities. The cost of travelling to those urban retail outlets can easily constitute one-third of the price of the motor pump. For example, those using motorized pumps for irrigation in Livingstone, in the southwest corner of Zambia, stated that they buy their motor pumps from individual traders who bring them from shops in South Africa while there are others who buy pumps from companies in Lusaka 500 kilometers (km) away. Although there is a demand for motor pumps in rural areas, apparently this demand has not reached the critical mass as yet to incite formal retailers to open up new sales points in rural areas. Purchases over long distances and from informal individual traders fill the gap.

The centralized nature of the supply chain also means that farmers in remote rural areas are poorly informed about the range of available makes and models of pumps, and, as elaborated below, their prices.

This centralized nature of the supply chain, with only a few specialized retailers, implies that spare parts and after-sales services are also limited and at a distance. However, some retailers stated that they are prepared to train mechanics, living in areas where they have supplied goods, in the maintenance and repair of their equipment. These trained mechanics could also order spare parts from the retailers, who can dispatch them by public transport to the required areas. However, this is not happening as yet.

The implications are sub-optimal use of the pumps, as found during the farm visits. Farmers appeared to lack information and skills on how to use their pumps properly. For example, some failed to use proper foot-valves, so that the pump sucked water mixed with soil. This caused pump seals to quickly wear out. This indicates the imperfection in the supply chain in the provision of after-sales services, information and training.

## **Fiscal Measures**

Retail prices can be influenced by governments through fiscal measures. As mentioned previously, Zambia introduced two fiscal measures with the aim of supporting, among others, the supply of farm equipment to smallholders: (a) in 2003, the government introduced an import duty waiver on irrigation equipment and pumps for agricultural and horticultural purposes; and (b) in 2009, it issued a VAT zero rating on the importation of small-scale agricultural equipment, including portable motor pumps. The ZRA published these measures as 'Statutory Instruments' in the Government Gazette, but no specific additional publicity measures were taken. An importer and a retailer may use these 'savings' to gain a reduction in the retail price to increase the number of sales; the savings can be used for investments to open up new markets in more remote areas; or both strategies can be combined to further perfect the supply chain.

However, the first question is whether, and how, these fiscal measures are applied in practice. The VAT zero rating on agricultural equipment, inclusive of portable motor pumps, is well known to the buyer as it appears on the receipt issued for the purchase as '0% VAT'. The import duty waiver on irrigation equipment does not appear on any documents issued to the buyer; it only appears on customs clearance documents prepared by clearing agents and copied to the importer.

We first discuss the different measures and then present the findings on how they are applied in practice.

### ***VAT Zero Rating and Import Duty Waiver***

The VAT in Zambia is currently 16%; VAT is normally collected at each stage of the supply chain, where VAT value is added to goods or services. A business incurs input VAT when purchasing goods or services and charges output VAT when supplying goods or services. At the end of each tax period, the VAT due is arrived at by deducting the total input tax from the total output tax.

Any company with an annual turnover of more than USD 40,000 is registered for VAT purposes and any company with a turnover of less than USD 40,000 is not registered.

Since February 2009 (Statutory Instrument (SI) No. 3 of 2009), a variety of agricultural equipment and spare parts, inclusive of motor pump sets, were given an input VAT zero rating. This means that the importer does not pay input VAT on these items and the wholesaler or retailer does not charge the buyer output VAT.

**Import duty** on irrigation equipment would normally be 15%. However, since 2003 (Statutory Instrument (SI) No. 13 of 2003) there has been a suspension of duty on irrigation equipment and pumps for agricultural and horticultural purposes. Duty-free importation of pumps was possible until the end of 2011 only for organizations that were exempted by ZRA. However, since SI No. 31 of 2011 became effective on December 28, 2011, all portable motor pumps can be imported duty-free under Customs Code 8413.19.90.

This case study was conducted before SI No. 31 of 2011 became effective.

### *The Application of the Import Duty Waiver, VAT Zero Rating and Company Tax*

The following generic scenarios were developed from visits to nine companies in the capital city, Lusaka, that were importing their own pumps:

- Large companies that are recognized as being providers of agricultural and irrigation equipment and services import pumps duty-free.
- Large companies that are general retail stores import pumps for general purposes, so they have to pay duty.
- Any large company with an annual turnover of more than USD 40,000 is registered for VAT purposes, but the pumps they import are issued a VAT zero rating. Such a company pays a 35% Company Tax.
- Small companies that operate small retail stores import pumps for general purposes, so they have to pay duty.
- Any small company with an annual turnover of less than USD 40,000 is not registered for VAT purposes, so it does not charge the buyer VAT. Such a company only pays a 3% Turnover Tax.
- Small individual importers of pumps are quite common; they import pumps for general purposes, so they are supposed to pay duty. Since they operate in the informal sector, there is no formally registered information on the way that they import.

The scenarios described above are summarized in Table 1.

TABLE 1. Different duty, VAT and company tax scenarios for portable motor pumps.

Typical category of importer	Import duty		VAT		Taxation	
	Purpose of pump importation	Import duty payable	VAT registered	VAT payable	Turnover (USD)	Tax payable
Large agricultural and irrigation equipment store	Irrigation	<b>0%</b>	Yes	<b>0%</b> ( <i>agricultural equipment is VAT zero rated</i> )	> 40,000	<b>35% Company Tax</b>
Large general retail store	General purpose	<b>15%</b>				
Small general retail store	General purpose	<b>15%</b>			< 40,000	<b>3% Turnover Tax</b>
Small individual trader - informal sector	General purpose	<b>15%</b>	No	<b>0%</b>	No information	No information

During the interviews with the different categories of companies, indications were given of the above scenarios. However, it was not possible to get the details of exactly how each company was handling exemptions related to the import duty waiver on pumps. Some companies did not seem to know how to go about the import duty waiver, while others did seem to know but did not explain in detail how they handled these exemptions.

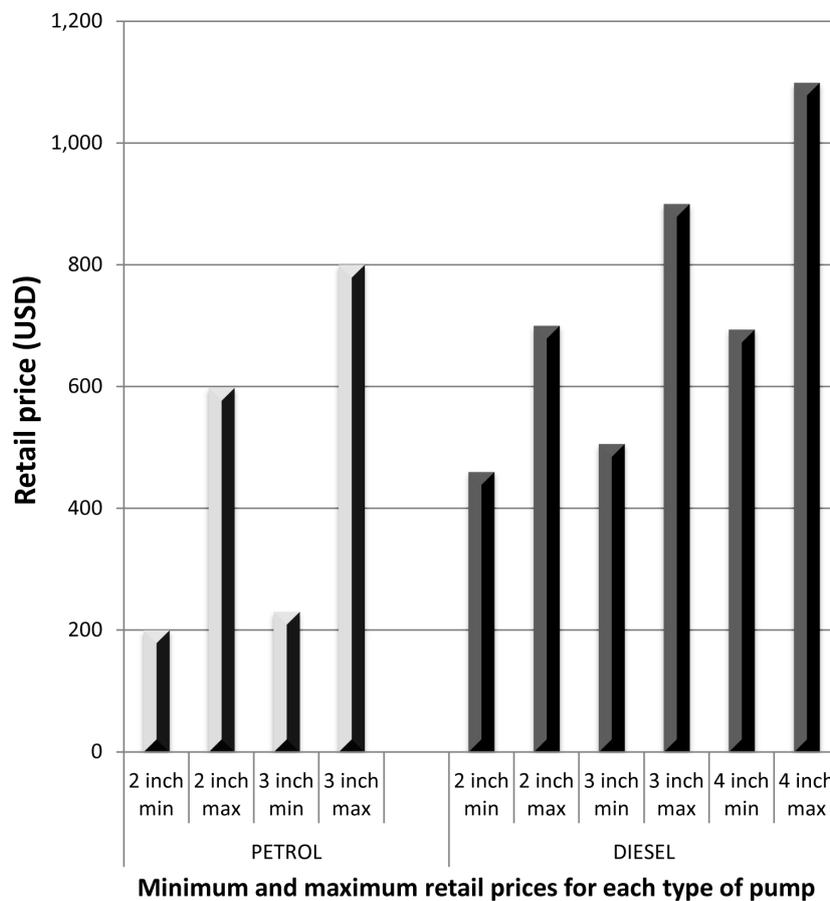
ZRA stated that there is often a misunderstanding between the authority and importers/farmers on the classification of goods, and hence it is advisable to seek regular advice on classification, especially prior to importation of the goods.

## Retail Prices

Prices strongly influence rates of farmers' adoption of motorized pumps. A comparison was made between the retail prices of different sizes of pumps, as measured by the diameter of the outlet of the pump. The findings are based on a total number of 41 different pump makes and models. The analysis highlighted important differences in prices by type of fuel (diesel or petrol), country of origin, and, last but not least, by retailer. Overall, the prices of pumps ranged from the cheapest 2-inch petrol pumps (USD 200) to the more expensive 4-inch diesel pumps (USD 1,000).

Figure 4 shows the comparison between the minimum and maximum retail prices of pumps fuelled by petrol or diesel, for the same pump diameter.

FIGURE 4. Minimum and maximum retail prices by type and size of pump.



The figure shows that price differences between same-sized petrol pumps are much larger than between same-sized diesel pumps. Diesel pumps are always more expensive than petrol pumps of the same size, because the diesel engines that drive the pump are more expensive to manufacture. The pumps that are connected to a diesel or petrol engine are of the same type and price range.

The country of manufacture of the pump also influences its retail price. As shown in Table 2, Thai petrol pumps are 16 to 39% more expensive than the Chinese pumps. Petrol pumps from Japan are up to approximately 160% more expensive than the Chinese petrol pumps.

Diesel pumps from Japan are 55% more expensive than diesel pumps from China. The price difference between Japanese and Chinese pumps is much smaller for diesel pumps than for petrol pumps. The cheapest petrol pump models, usually made in China, are of rather poor quality and there is a lack in the supply of good spare parts. However, these pumps can still last for a year or two. There is a demand for these pumps, especially from farmers who, for the first time, shift from using a bucket or treadle pump for irrigation. The expensive pumps are bought by the more experienced farmers who are replacing their cheap start-up pumps.

TABLE 2. Average retail prices by type of pump and country of manufacture.

Country of origin	Average retail price (USD)			Higher retail price compared to Chinese pumps	
	China	Thailand (Honda Motor Co. Ltd., Thailand)	Japan	Thailand/China	Japan/China
Pump size/capacity					
2" petrol pump	245	285	600	16%	145%
3" petrol pump	270	375	700	39%	160%
2" diesel pump	570	No data	No data		
3" diesel pump	580	No data	900		55%
4" diesel pump	800	No data	No data		

A third price analysis compared prices of the same makes and models of pumps, but from different retail outlets. There were remarkable differences in the retail price for exactly the same make and model of pumps between the different retail outlets. The differences within the capital city, Lusaka, were between upmarket large agricultural retail shops and the smaller downtown market shops, in the same markets where smallholders are selling their crops. Pumps appeared to be cheaper in the large shops, which also provide spare parts and a good after-sales service. Some of the bigger shops are even giving warranties on the portable motor pumps they sell, usually for a period of 6 months. This points at diverse marketing strategies of the different retailers. Reasons for this have still to be identified, but one reason could be the economies of scale. The large shops import large quantities at once, just before the season starts. They also know the procedure for importing duty-free. However, we could not find evidence that importing duty-free guarantees a lower retail price.

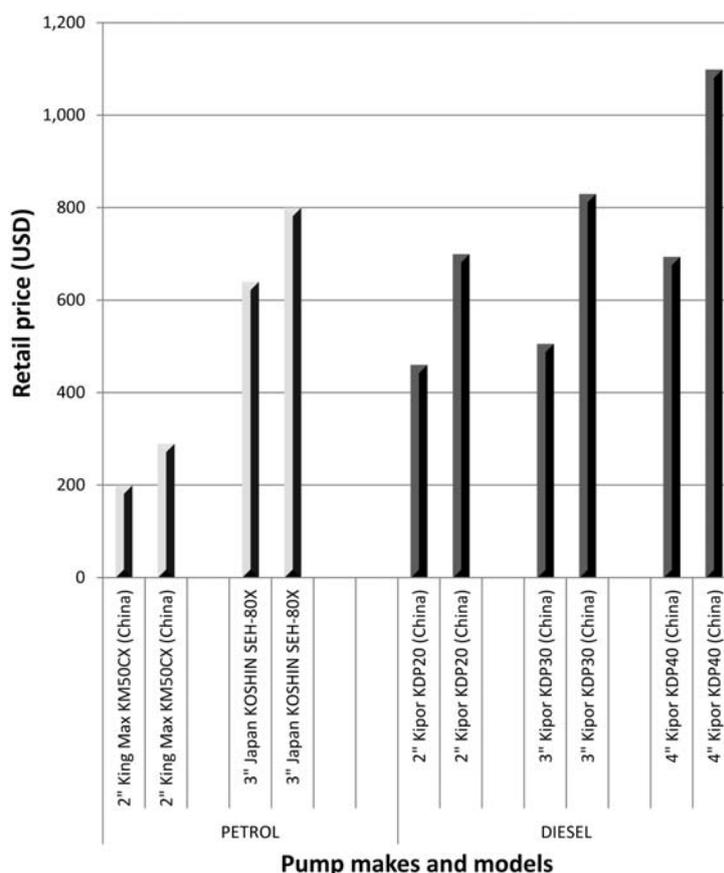
In general, prices for any goods are lower in small market shops than in larger shops, but this is not the case for motor pumps.

Other considerable retail price differences (up to 60%) were found between shops in Lusaka and a shop in a provincial town (for pump models, Kipor KDP 30 and KDP 40 (see Figure 5)).

The fact that some clients buy pumps from expensive retail outlets shows that there is a lack of information on retail prices, which is another imperfection of the supply chain.

Figure 5 shows the difference in retail prices for the same makes and models of pumps charged by different retail outlets.

FIGURE 5. Retail price variation between suppliers of same makes and models of pumps.



### Financing Facilities: Loans and Subsidies

With the given retail prices, the provision of financing facilities enables smallholders to make the investment in purchasing pumps. This increases the demand for pumps. For irrigation pumps, the expensive capital costs are the major hurdle, although recurrent energy costs can also lead to temporary or permanent reverting to the use of buckets or other manual lifting devices for irrigation. Focusing on the financing facilities for the capital costs, this study identified various ways in which, especially, NGOs and MFIs currently enable smallholders to make the purchase and how facilities can be improved in the future.

Financing facilities range from being fully commercial (either formal or informal) to fully subsidized. Subsidies to smallholders can be given indirectly, by supporting MFIs setting up credit facilities, or directly, either with the provision of discount vouchers to purchase pumps or by giving pumps for free. Findings on the various forms of financing facilities are discussed in this order.

In general, rural Zambians have very limited access to commercial financing facilities for any item, including motor pumps. A comparative study of nine African countries ranked Zambia with almost the highest proportion of people (63%) who are excluded from any financing services, only after Mozambique. Table 3 shows the findings of a study by FinScope Zambia (2009). When comparing rural areas to urban areas, the people in rural areas have: much less access to banks; the same access to non-bank financial institutions; more access to informal financial products; and less access to financial services in general. When comparing males to females, females have: less access to banks; the same access to non-bank financial institutions and informal financial products, and less access to financial services in general, which is mainly due to having less access to banks.

TABLE 3. Access to financing facilities in Zambia.

			2009					
			2005	2009	Urban	Rural	Female	Male
Financially included	Formally served	Access to banks	15%	14%	23%	9%	11%	17%
		Access to non-bank financial institutions	8%	9%	9%	9%	9%	9%
		Access to informal financial products	11%	14%	10%	17%	14%	14%
Financially excluded		No access to any financial product	66%	63%	58%	66%	66%	59%

Source: FinScope Zambia 2009.

Table 3 also shows that the use of banks even decreased between 2005 and 2009. However, there was a small increase in the use of non-bank financial institutions and in the use of informal financial products between this period.

Most of the 24 MFIs in Zambia registered with the Bank of Zambia and operate in urban and peri-urban areas. They obtain loans from DFIs, such as the Development Bank of Zambia (DBZ) or the African Development Bank (AfDB), at a reduced interest rate, namely, for loans in the local currency (ZMK) it is 2.5% below the Treasury Bill Rate; and for loans in USD it is 1% below the London Interbank Offered Rate (LIBOR). The cost of expanding operations into remote rural areas is prohibitive and is only possible with some form of external assistance. The Rural Finance Program (RFP 2007-2013) of the Ministry of Finance and National Planning has as its main aim to increase the use of sustainable financial services in rural areas. The RFP channels funding from the International Fund for Agricultural Development (IFAD) to DBZ, which, in turn, is wholesaling the facility to MFIs. Some MFIs are getting grants through DFIs to enable them to start operating in more remote rural areas. MFIs do not necessarily deal with the end-user (farmer) only. Some have a provision for what they call 'Value Chain Financing', which means that they can finance any actor in the value chain.

Only a few MFIs deal specifically with loans to farmers and only one of them (Christian Enterprise Trust of Zambia (CETZAM)) specializes in loans for irrigation equipment.

The few MFIs in rural areas that provide credit facilities to smallholders, give loans to smallholders who would not qualify for loans from commercial banks due to the lack of collateral. This is claimed to justify much higher interest rates than those of commercial banks. Usually, the loans are small and for a few months only. When MFIs give loans for pumps, this is at an interest rate of about 4 to 5% per month. They generally recover the loan within 6 months (3 months grace

period, 3 months repayment). The interest rates are 30 to 50% per annum. Some of the MFIs buy the pumps on behalf of their client farmers, while others let the farmer buy the pump of their choice within the agreed credit limit. Farmers tend to prefer the latter arrangements. The interviewed MFIs were not well informed about where to buy the best pump at the best price.

Discount vouchers support smallholders and the pump supply chain more directly. In Zambia, they have been provided for the promotion of treadle pumps, but not for motor pumps as yet. However, a similar system could be made possible for motor pumps in the future. For the treadle pumps, a subsidy of 40% of the value of the irrigation equipment was provided by the Mennonite Economic Development Associates (MEDA), in the form of a discount voucher whereby the farmer pays the remaining 60%. This means that the farmer buys the equipment at a discount of 40%. The supplier redeems the value of the voucher from the issuer, and receives the normal retail price for the equipment. Hence, there is no market distortion. The supplier as well as the farmer benefit from this kind of subsidy, as it creates a higher demand for the equipment.

Finally, pumps can be given for free. Such free distribution of pumps has occurred, for example, in the intensively irrigated areas in Katuba area, 20 km north of Lusaka. A NGO distributed 30 portable motor pumps free of charge to female, mixed and male groups of smallholders to promote the use of pumps in a particular area. The project's targeting of women and mixed groups ensured that more female-headed households got access to the motor pumps than they would have done if they had to acquire the pumps privately (Colenbrander et al. 2011). Distribution for free can be justified to promote innovation, create a critical mass and target specific groups, such as female-headed households. However, in the long-term or at wider scales, it distorts markets.

## CONCLUSIONS AND RECOMMENDATIONS

Returning to the research questions – what is the nature of the supply chain of portable motorized pumps in Zambia and what are the current imperfections? How can farmer organizations, the government, donors and NGOs address those imperfections to accelerate motor pump adoption by smallholders? The foregoing findings show that the supply chain is imperfect. In no link in the chain is the flow of information and goods and services optimal. These imperfections can partially be attributed to the fact that the supply chain only started a decade ago. Yet, these imperfections need to be addressed, so that any smallholder in Zambia who wants to obtain a motorized pump is also able to do so and use the pump sustainably. This would accelerate the uptake of small mechanized private irrigation in Zambia.

The pump supply chain is primarily imperfect in the sense that the provision of goods and services is centralized in Lusaka and a few other urban centers, while smallholders live far from those centers. This applies to retail outlets, the after-sale services provided by retail outlets and to the provision of credit facilities. Within these urban hubs, there is some competition; it is not a matter of monopoly by the few. Yet, this centralization negatively affects smallholders' access to goods and services and, hence, a well-functioning supply chain.

The supply chain is further imperfect because information is concentrated only among a few. This is most striking with regard to the prices of pumps, which vary strongly. Yet, even NGOs and MFIs are unaware of this, let alone farmers. Further, the large import and retail companies and, of course, ZRA and the customs clearing agents are well informed about the procedures involved in obtaining the import duty waiver and VAT zero rating. However, even during this study, it appeared difficult to obtain that information. The smaller retail outlets and the MFIs who deal with agricultural loans are not, or only partly, informed about the import duty waiver, about the best price for the best pump and about provision of after-sales services.

Smallholder farmers are the least informed. They are in an isolated position in the supply chain: not well informed and not in a position to influence processes in the chain. They lack information on available pump makes and models, retail prices and price differences between retail outlets, the availability of spare parts and after-sales services. They lack information and training on the proper use and preventive maintenance of the pumps.

These asymmetries in goods, services and information suggest that improvements in smallholders' accessibility and information are key to accelerate the flows in the supply chain. Yet, it is not feasible for retailers to decentralize and set up outlets in rural areas as long as the effective demand for pumps is limited. Neither is it feasible for MFIs to set up branches in rural areas if their potential client base is small or perceived to be small. The government and NGOs can play supportive roles, but also lack a sufficient basis to reach all potentially interested smallholders in rural areas.

This conundrum cannot be solved by many isolated individual farmers, but organized farmers, such as ZNFU, could be highly effective. The ZNFU, which is well decentralized through its district associations, could unlock each component of the pump supply chain. They could negotiate with a supplier to bring in pumps at a negotiated price, favorable for the supplier as well as the farmer. On the other hand, farmers' associations that have the capacity, could import pumps themselves. Further, they could make information available on the range of portable motor pumps that are available for irrigation in Zambia, their specifications, the sources of supply and the retail prices with the different retailers. They could negotiate the supply of pump spare parts, so that individual farmers do not have to travel long distances to purchase these. They could explore the observed willingness of retailers to train local mechanics in the maintenance and repair of pumps supplied. They could get information on the exact procedures that need to be followed to import portable pumps duty-free and obtain the VAT zero rating from ZRA. They could agree with ZRA on how best these procedures can be made public. Farmers' associations could also approach MFIs and provide them with information that is useful for market research carried out by MFIs. This could all be achieved through advertisements in the print media and through radio and TV; and ZNFU could include a publication in their magazine. In that way, smallholders will become the pulling force behind the accelerated mechanization of private irrigation in Zambia.

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## APPENDIX 1. INTERVIEW CHECKLIST FOR THE DIFFERENT ACTORS IN THE MOTOR PUMP SUPPLY CHAIN.

CHECKLIST	ACTORS IN THE PUMP SUPPLY CHAIN									
	Retail shops	Zambia Revenue Authority (ZRA)	Customs clearing agent	Non-governmental Organizations (NGOs)	Zambia National Farmers Union (ZNFU)	Small-scale irrigation farmers	Micro-finance institutions (MFIs)/projects	Energy Regulation Board	Zambia Electricity Supply Corporation (ZESCO)	Ministry of Agriculture & Cooperatives
<b>Importation and retail</b>										
Who are the private retailers and other private or public suppliers of motor pumps?	x	x	x	x	x	x	x			x
How is the supply chain of pumps, spare parts and after-sales services organized?	x	x	x	x	x	x	x			x
What are the prices and mark-ups? Which components are subsidized and by whom?	x	x	x	x	x	x	x			x
What are the sales and where?	x	x	x	x	x	x	x			x
What is the availability of petrol and electricity?								x	x	
<b>Import duty waiver and VAT zero rating</b>										
What were drivers of the tax policy reform?		x								x
How is the tax policy with regard to small-scale irrigation equipment implemented?	x	x	x	x	x	x				x
What is already realized and what is the potential impact of the import duty waiver and VAT zero rating on agricultural equipment for irrigation technology adoption by small-scale farmers?	x	x	x	x	x	x				x
<b>Financing and subsidies</b>										
Are credit facilities available to retailers and/or buyers, and, if so, at which interest rates; and how are they organized and how widespread is its use?	x					x	x			x
How and to which components of retail and purchases are subsidies provided, and by whom? How do they favor, or not, widespread and sustainable dissemination and uptake by small-scale farmers?	x	x	x	x		x	x			x
What is the experience with voucher systems for pumps in Zambia? Would that be a solution for widespread dissemination of irrigation equipment? If so, how?	x			x		x	x			x
<b>General</b>										
Which future measures could unlock the supply chain to enable massive dissemination?	x	x	x	x	x	x	x			x

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